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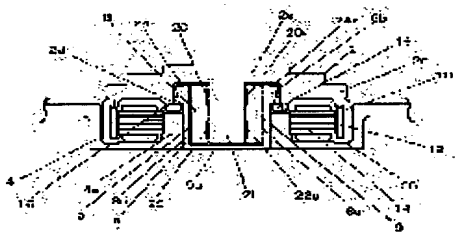
(54) SPINDLE MOTOR AND DISK DRIVE PROVIDED WITH THE SAME

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a spindle motor and disk drive capable of making compact and thin, and avoiding air bubbles caused by negative pressure and a excessive floating of a rotor, and suppressing the occurrence of contact and sliding on a bearing.
SOLUTION: The thrust bearing with a hydrodynamic pressure generating groove of such a shape that a pressure acting to oil inwardly in the radial direction is given, is formed between an end face at an end side of an opening of a bearing member and a flat surface of the rotor. The radial bearing with a hydrodynamic pressure generating groove in which its shape is arranged to give pressure to oil from both sides of an axial direction is formed between an inner peripheral surface of a bearing bore and an outer peripheral surface of a shaft. A connecting hole is formed on the bearing member. Thereupon, the connecting hole has an opening inwardly to a radial direction of the thrust bearing at one side, and is connected with both side of a bearing gap in an axial direction formed between an inner peripheral surface of a bearing bore and an outer peripheral surface of a shaft, and keeps pressure in the bearing gap.



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CLAIMS

[Claim(s)]
[Claim 1]
On the other hand, it is the spindle motor which comes to have the cylindrical bearing member of opening and Rota rotated with this shaft for which it has the lock out end face which counters in the end face and the direction of an axis of a shaft, and the bearing hole in which this shaft is inserted and this shaft,
Said Rota has the periphery-like flat side extended from the peripheral face of said shaft to the method of the outside of radial,
Between the flat side of said Rota and said shaft, and said bearing member, a series of bearing clearances filled with oil are formed,
Between the opening one end end face of said bearing member, and the flat side of said Rota, the thrust bearing section in which the dynamic pressure generating slot of the configuration which gives the pressure which acts on the method side of the inside of radial to said oil at the time of rotation of said Rota was established is formed,
Between the inner skin of said bearing hole, and the peripheral face of said shaft, the radial bearing section in which the dynamic pressure generating slot of the configuration which gives the pressure which acts from the direction both sides of an axis to said oil at the time of rotation of said Rota was established is formed,
The spindle motor characterized by what it is open for free passage to the direction both ends of an axis of the bearing clearance formed between the inner skin of said bearing hole, and the peripheral face of said shaft, and the free passage hole which aims at balance of the pressure in the bearing clearance concerned is formed in said bearing member for while one of these carries out opening to the method of the inside of radial of said thrust bearing section.
[Claim 2]
The spiral slot of a pump in configuration is established in said thrust bearing section as said dynamic pressure generating slot. Moreover, said radial bearing section While estranging in the direction of an axis and carrying out the pair configuration between the peripheral face of said shaft, and the inner skin of said bearing hole Among the radial bearing sections of this pair, at least in one of the radial bearing sections The spindle motor according to claim 1 characterized by what the herringbone slot of an imbalanced configuration is prepared in the direction of an axis which presses said oil from opening one end of said bearing member to lock out one end as said dynamic pressure generating slot for.
[Claim 3]
While holds bell shape sleeve and this sleeve in which said bearing hole was established, and said bearing member consists of cup-like bearing housing with which the edge was blockaded. Said thrust bearing section It is the spindle motor according to claim 1 or 2 characterized by what said free passage hole is constituted for by the direction slot of an axis formed in the peripheral face of this sleeve, and the inner skin of this bearing housing while being formed between the other-end section side edge side of this bearing housing, and the flat side of said Rota.
[Claim 4]
The cylinder wall which hangs from said flat side in said Rota, and counters radial through the peripheral face and gap of said bearing housing is established. To the peripheral face of said bearing housing It is the spindle motor according to claim 3 which a taper side is established so that an outer diameter may reduce the diameter as it separates from the flat side of said Rota, and is characterized by what said oil forms a meniscus and is held for between this taper side and the inner skin of this cylinder wall.
[Claim 5]
The step a peripheral face carries out [the step] a cavity to the method of the inside of radial succeeding said taper side is prepared in said bearing housing. To the inner skin of the cylinder wall of said Rota By the annular member which projects in the method of the inside of radial corresponding to this step fixing, and this step and

this annular member being engaged The omission stop of said Rota is constituted. Between the top face of this annular member, and the inferior surface of tongue of this step The spindle motor according to claim 4 characterized by what the **** minute gap is formed rather than the minimum clearance dimension of the radial gap formed between the taper side of said bearing housing, and the inner skin of the cylinder wall of said Rota, and is functioned as a labyrinth seal.

[Claim 6]

Said Rota is a spindle motor according to claim 1 to 5 characterized by what is energized by the magnetic force which acts in the direction of an axis toward the lock out end-face side of said bearing member.

[Claim 7]

In the disk driving gear with which it is equipped with the disc-like record medium which can record information, it is the disk driving gear which has housing, the spindle motor which is fixed to the interior of this housing and made to rotate this record medium, and an information access means for writing in or reading information to the necessary location of this record medium,

Said spindle motor is a disk driving gear characterized by what is been the spindle motor indicated to claim 1 thru/or either of 6.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]
This invention relates to the disk driving gear equipped with the spindle motor and this which use the hydrodynamic bearing which uses oil as a working fluid.
[0002]
[Description of the Prior Art]
In order to support a shaft and a sleeve as bearing of the spindle motor used from the former in the disk driving gear which drives record disks, such as a hard disk, enabling free relative rotation, the hydrodynamic bearing using the fluid pressure of lubrication fluids, such as oil made to intervene among both, is proposed variously.
[0003]
An example of the spindle motor which uses such a hydrodynamic bearing is shown in drawing 1 . The spindle motor which uses this conventional hydrodynamic bearing Between the peripheral face of the shaft b which makes Rota a and one, and the inner skin of the sleeve c in which this shaft b is inserted free [rotation] The radial bearing sections d and d of a pair estrange in the direction of an axis, and are constituted. Moreover, between the thrust bushes f which blockade the inferior surface of tongue of a thrust plate e, and one opening of Sleeve c in the list between the top face of the disk-like thrust plate e which projects in the method of the outside of radial from one edge outside peripheral surface of Shaft a, and the flat sides of the step formed in Sleeve c The thrust bearing sections g and g of a pair are constituted.
[0004]
In a shaft b list at a thrust plate e and a sleeve c list between thrust bushes f A series of minute gaps are formed. All over these minute gaps It is held continuously, without oil breaking off as a lubrication fluid. It has exposed to air only within the taper seal section h prepared in upper limit section opening (opening of another side of Sleeve c) of the gap formed between the peripheral face of Shaft b, and the inner skin of Sleeve c (such oil maintenance structure is described as "full philharmonic structure" below).
[0005]
Moreover, the herringbone grooves d1 and d1 which come to connect the spiral groove of a pair, and g1 and g1 are formed in the radial bearing sections d and d and the thrust-bearing sections g and g, the maximum dynamic pressure is generated in the center section of bearing in which the connection section of a spiral groove is located according to rotation of Rota a, and the load which acts on Rota a is supported.
[0006]
[Problem(s) to be Solved by the Invention]
If Rota a begins rotation in the hydrodynamic bearing of full philharmonic structure, oil is the dynamic pressure generating slots d1 and d1 and a pumping by g1 and g1, and while it is drawn in the core side of each radial bearing sections d and d and the thrust bearing sections g and g and fluid dynamic pressure serves as the maximum in the core of bearing, the internal pressure of oil will fall by the edge side of bearing. Namely, the inside of the field between the peripheral face of Shaft b, and the inner skin of Sleeve c, The inside of the field around the oil held among the radial bearing sections d and d of a pair, and a thrust plate e, The internal pressure of oil falls according to the dynamic pressure generating slots d1 and d1 and the pumping of g1 and g1, and the oil held near the periphery section of the thrust plate located among the thrust bearing sections g and g falls below to atmospheric pressure soon, and serves as negative pressure.
[0007]
If negative pressure arises in oil, for example at the time of a filling-with-oil activity etc., the air which melted in oil will air-bubbles-ize, and it will appear. The problem which influences the endurance and dependability of a spindle motor of air bubbles carrying out cubical expansion and making oil leak to the bearing exterior by a temperature rise etc. soon, Or the problem on which a dynamic pressure generating slot influences the rotation

precision of a spindle motor called generating of vibration and the aggravation of NRRO (non-repeatability deflection component) by contacting air bubbles occurs.
[0008]
In addition, when the radial-clearance dimension of the minute gap which originates in a processing error etc. and is formed between the inner skin of a sleeve and the peripheral face of a shaft is larger than an upper limit section side and the direction lower limit section side of an axis is formed etc., When imbalance arises in the pumping of the dynamic pressure generating slots d1 and d1 in the radial bearing sections d and d From the pressure of the direction upper limit section of an axis serving as high pressure from the direction lower limit section of an axis, the oil held between the inner skin of a sleeve, and the peripheral face of a shaft A pressure spreads from the direction upper limit section side of an axis to a lower limit section side, the internal pressure of the oil held between the inferior surface of tongue of a thrust plate and a thrust bush increases beyond the need, and fault surfacing to which Rota surfaces more than the specified quantity occurs.
[0009]
If fault surfacing occurs in Rota, wear by contact to a thrust plate and a sleeve will occur, and it will become the cause which spoils dependability in the endurance list of bearing. In addition, since contiguity arrangement of the recording surface and the magnetic head of a hard disk is extremely carried out with high-capacity-izing of a hard disk in the case of the spindle motor for a hard disk drive, there is concern which destruction by contact to a hard disk and the magnetic head generates.
[0010]
It aims at offering the disk driving gear equipped with the spindle motor and this which can control contact of bearing, and generating of sliding while thin-shape-izing is possible for this invention in a miniaturization list and it prevents generating of the air bubbles resulting from negative pressure, and fault surfacing of Rota.
[0011]
[Means for Solving the Problem]
While invention according to claim 1 has the end face of a shaft, and the bearing hole in which this shaft is inserted and this shaft, and the lock out end face which counters in the direction of an axis, the cylindrical bearing member of opening, It is the spindle motor which comes to have Rota rotated with this shaft. Said Rota It has the periphery-like flat side extended from the peripheral face of said shaft to the method of the outside of radial. Between the flat side of said Rota and said shaft, and said bearing member A series of bearing clearances filled with oil are formed. Between the opening one end end face of said bearing member, and the flat side of said Rota The thrust bearing section in which the dynamic pressure generating slot of the configuration which gives the pressure which acts on the method side of the inside of radial to said oil at the time of rotation of said Rota was established is formed. Between the inner skin of said bearing hole, and the peripheral face of said shaft The radial bearing section in which the dynamic pressure generating slot of the configuration which gives the pressure which acts from the direction both sides of an axis to said oil at the time of rotation of said Rota was established is formed. To said bearing member While one of these carries out opening to the method of the inside of radial of said thrust bearing section, it is open for free passage to the direction both ends of an axis of the bearing clearance formed between the inner skin of said bearing hole, and the peripheral face of said shaft, and the free passage hole which aims at balance of the pressure in the bearing clearance concerned is formed.
[0012]
This configuration makes it possible to prevent generating of fault surfacing in a negative pressure list in the spindle motor which used the hydrodynamic bearing of full philharmonic structure.
[0013]
By namely, the thing for which the direction both ends of an axis of the bearing clearance formed between the inner skin of a bearing hole and the peripheral face of said shaft are opened for free passage, and circulation of oil is enabled with a free passage hole It originates in the dimensional tolerance of the dynamic pressure generating slot established in the radial bearing section, the processing error of bearing hole inner skin or a shaft peripheral face, etc. Also when differential pressure arises at the direction of axis vertical edge of the oil held between the inner skin of a bearing member, and the peripheral face of a shaft, differential pressure is compensated through a free passage hole, and the negative pressure in oil and generating of fault surfacing of Rota are prevented.
[0014]
Moreover, the pressure drop of the oil which generates the pressure compensation in oil by carrying out in the field sealed by the thrust bearing section in pressure at the time of moderation of a motor etc. is made loose, it becomes possible to control contact and sliding of bearing, and dependability and endurance can be maintained highly.

[0015]
Invention according to claim 2 is set to a spindle motor according to claim 1. In said thrust bearing section The spiral slot of a pump in configuration is prepared as said dynamic pressure generating slot. Moreover, said radial bearing section While estranging in the direction of an axis and carrying out the pair configuration between the peripheral face of said shaft, and the inner skin of said bearing hole The herringbone slot of an imbalanced configuration is prepared in the direction of an axis which presses said oil from opening one end of said bearing member to lock out one end as said dynamic pressure generating slot among the radial bearing sections of this pair at least at one of the radial bearing sections.
[0016]
Invention according to claim 3 is set to a spindle motor according to claim 1 or 2. Said bearing member While holds bell shape sleeve and this sleeve in which said bearing hole was established, and it consists of cup-like bearing housing with which the edge was blockaded. Said thrust bearing section While being formed between the other-end section side edge side of this bearing housing, and the flat side of said Rota, said free passage hole is constituted by the direction slot of an axis formed in the peripheral face of this sleeve, and the inner skin of this bearing housing.
[0017]
Invention according to claim 4 is set to a spindle motor according to claim 3. The cylinder wall which hangs from said flat side in said Rota, and counters radial through the peripheral face and gap of said bearing housing is established. To the peripheral face of said bearing housing A taper side is established so that an outer diameter may reduce the diameter, as it separates from the flat side of said Rota, and between this taper side and the inner skin of this cylinder wall, said oil forms a meniscus and is held.
[0018]
Invention according to claim 5 is set to a spindle motor according to claim 4. In said bearing housing The step a peripheral face carries out [the step] a cavity to the method of the inside of radial succeeding said taper side is prepared. To the inner skin of the cylinder wall of said Rota By the annular member which projects in the method of the inside of radial corresponding to this step fixing, and this step and this annular member being engaged The omission stop of said Rota is constituted. Between the top face of this annular member, and the inferior surface of tongue of this step The **** minute gap is formed rather than the minimum clearance dimension of the radial gap formed between the taper side of said bearing housing, and the inner skin of the cylinder wall of said Rota, and it functions as a labyrinth seal.
[0019]
Invention according to claim 6 is energized for said Rota in the spindle motor according to claim 1 to 5 by the magnetic force which acts in the direction of an axis toward the lock out end-face side of said bearing member.

[0020]
In the disk driving gear with which it is equipped with the disc-like record medium which can record information, invention according to claim 7 is equipped with the spindle motor indicated to claim 1 thru/or either of 6 as said spindle motor while it has housing, the spindle motor which is fixed to the interior of this housing and made to rotate this record medium, and an information access means for writing in or reading information to the necessary location of this record medium.
[0021]
In addition, invention indicated to claims other than claim 1 is explained in full detail in the gestalt of implementation of the following invention, and an effect of the invention about the principle in the operation effectiveness list by the configuration of invention concerning each claim, in order to avoid the duplicate publication about the configuration adapted to the operation gestalt of this invention.
[0022]
[Embodiment of the Invention]
Although the **** operation gestalt of the disk driving gear hereafter equipped with the spindle motor and this concerning this invention is explained with reference to drawing 2 thru/or drawing 4 , this invention is not limited to the example shown below. In addition, although the vertical direction of each drawing is made into the "vertical direction" for convenience in explanation of this operation gestalt, the direction in the actual attachment condition of a spindle motor is not limited.
[0023]
(1) The configuration of a spindle motor
The spindle motor concerning the operation gestalt of this invention has Rota 2 which consists of rotor hub 2a and shaft 2b prepared in the center of rotation of this rotor hub 2a in the shape of the same axle, the housing 6 of the shape of a cylinder which fixed to circular boss section 4a prepared in the bracket 4, and the same bell

shape sleeve 8 attached in this housing 6 so that it may be illustrated by drawing 2 and drawing 3 . Flange-like disk installation section 2c in which record disks (it illustrates as a disk plate 52 in drawing 4), such as a hard disk, are laid is prepared in the periphery section of rotor hub 2a, and the inferior-surface-of-tongue side of this disk installation section 2c is equipped with York 10. The Rota magnet 12 is attached in the inner skin of this York 10 by means, such as adhesion. Moreover, the peripheral face of circular boss section 4a is countered radial [this / Rota magnet 12 and radial], and a stator 14 fixes.

[0024]

Housing 6 has the abbreviation cup-like configuration where the lower part side was blockaded by carrying out press working of sheet metal of the sheet metal-like metal material.

[0025]

The through tube (bearing hole) penetrated in the direction of an axis is prepared in the core, and shaft 2b is inserted in the sleeve 8 at this through tube. The peripheral face of shaft 2b countered radial through the inner skin and the gap of a sleeve 8, and the end face of shaft 2b has countered in the direction of an axis through the inside and gap of lock out edge 6a of housing 6. The sleeve 8 is attached so that the end face by the side of the upper part may serve as an end face by the side of the upper part of housing 6, and a height location of abbreviation identitas and the end face by the side of the lower part may counter in the direction of an axis through the inside and clearance of lock out edge 6a between housing 6. Furthermore, the end face by the side of the upper part of housing 6 and a sleeve 8 has countered in the direction of an axis through periphery-like the lower part side face (flat side) and gap of rotor hub 2a.

[0026]

The gap formed at these housing 6 list between the end face by the side of the upper part of a sleeve 8, and the lower part side face of rotor hub 2a, The gap formed between the inner skin of a sleeve 8, and the peripheral face of shaft 2b, The clearance formed between the end face by the side of the lower part of the sleeve 8 which adjoins the clearance and this which are formed between the inside of lock out edge 6a of housing 6, and the end face of shaft 2b, and the inside of lock out edge 6a of housing 6 (the clearance formed in the free passage hole 9 later mentioned in each of these clearance lists is doubled) It is continuing indicating it as a "bearing clearance" below altogether. In each clearance which these-continues, it is held continuously, without oil breaking off and the bearing of full philharmonic structure is constituted.

[0027]

Furthermore, direction slot of axis 8a which results in the end face by the side of a lower part is prepared in the peripheral face of a sleeve 8 from the end face by the side of the upper part, and the free passage hole 9 is formed of direction slot of axis 8a, and the inner skin of housing 6 by the sleeve 8 of such a configuration being attached in the inner skin of housing 6. The oil which oil is held also in this free passage hole 9, and is held in the gap formed between the inner skin of a sleeve 8 and the peripheral face of shaft 2b It is open for free passage through the free passage hole 9 in the clearance list formed between the gap formed between the end face by the side of the upper part of housing 6 and a sleeve 8, and the lower part side face of rotor hub 2a, the end face by the side of the lower part of a sleeve 6, and the inside of lock out edge 6a of housing 6. In addition, the free passage hole 9 is behind explained in full detail about pressure compensation of the oil which leads.

[0028]

Annular flange 6b formed in the shape of an inclined plane so that the diameter might be reduced as it protrudes on the method of the outside of radial and a peripheral face estranges from the upper limit side is prepared in the upper limit section of the peripheral face of housing 6. Moreover, 2d of peripheral wall sections which hang to a bracket 4 side is prepared in the radial heel of a lower part side face at rotor hub 2a. The inner skin of 2d of this peripheral wall section and the peripheral face of flange 6b have countered radial in the state of non-contact.

[0029]

The radial gap dimension of the gap specified between the inner skin of 2d of this peripheral wall section and the peripheral face of flange 6b is formed in the shape of an inclined plane as the peripheral face of flange 6b is the above, and it is increased gradually in the shape of a taper toward a bracket 4 side (the direction of a point of 2d of peripheral wall sections). That is, the inner skin of 2d of this peripheral wall section and the peripheral face of flange 6b collaborate, and the taper seal section 16 is constituted. Only in this taper seal section 16, the surface tension of oil and an outside atmospheric pressure balance, and, as for the oil held in each gap mentioned above, the interface of oil and air is formed in the shape of a meniscus.

[0030]

The taper seal section 16 has the movable formation location of an interface suitably according to the amount of oil which functions as an oil reservoir and is held in the taper seal section 16. Therefore, while the oil held in the taper seal section 16 is supplied to bearing later explained with reduction of the amount of oil maintenance,

the oil of the part to which the volume increased by thermal expansion etc. is held in this taper seal section 16.

[0031]
Thus, a taper-like gap is formed between the peripheral face of flange 6b of housing 6, and the inner skin of 2d of peripheral wall sections of rotor hub 2a, and with constituting the taper seal section 16 using surface tension, while the taper seal section 16 serves as a major diameter more, it can consider as size in [the direction dimension of an axis of the taper seal section 16] comparison. Therefore, the volume in the taper seal section 16 increases, and imitation becomes possible enough also to the thermal expansion of the oil held so much at the hydrodynamic bearing of full philharmonic structure.
[0032]
To the point, the annular ****** ring 18 has fixed with means, such as adhesion, rather than the taper seal section 16 of 2d of peripheral wall sections. Rota 2 to housing 6 falls out, and stop structure consists of that this ****** ring 18 fits in each other in the state of non-contact to the lower part of flange 6b. Thus, alignment arrangement of the radial bearing section and ****** structure of a pair which are explained in full detail behind is not carried out on the same line in the direction of an axis with constituting the ****** structure of Rota 2 in the peripheral face side of housing 6. Therefore, it becomes possible to utilize effectively the whole height dimension of the direction of an axis of the peripheral face of shaft 2b and the inner skin of a sleeve 8 which counter mutually as bearing, and thin shape-ization of the further motor is realized, maintaining bearing rigidity.
[0033]
The inner skin of the ****** ring 18 and the peripheral face of housing 6 have countered the inferior-surface-of-tongue list of the top face of the ****** ring 18, and flange 6b through the gap which follows the taper seal section 16 and has a **** clearance dimension rather than the minimum clearance dimension of the radial gap of the taper seal section 16.
[0034]
By setting up as small as possible the gap dimension of the radial clearance formed in the gap list of the direction of an axis specified between the top face of the ****** ring 18, and the inferior surface of tongue of flange 6b between the inner skin of the ****** ring 18, and the peripheral face of housing 6, at the time of rotation of a spindle motor A difference with the rate of flow of the air in the radial gap specified in the rate of flow and the taper seal section 16 of air in the gap between these ****** ring 18 and housing 6 becomes large. Effluent resistivity to the exterior of the steam produced when oil evaporated is enlarged, and vapor pressure [/ near the interface of oil] is kept high, and it functions as a labyrinth seal so that evapotranspiration of the further oil may be prevented.
[0035]
Thus, the outflow of the oil as a liquid is not only prevented, but it becomes possible by preparing a labyrinth seal succeeding the taper seal section 16 to also prevent the outflow to the motor exterior of the oil mist generated because oil evaporates by the rise of the external-environment temperature of a motor etc. Therefore, the fall of the amount of oil maintenance can be prevented, the bearing engine performance stabilized over the long period of time can be maintained, and it can consider as bearing with high endurance and dependability.
[0036]
(2) The configuration of bearing
So that drawing 3 (a) may be the sectional view of a sleeve 8 and it may be illustrated by this to the inner skin of a sleeve 8 Moreover, in order to carry out induction of the fluid dynamic pressure to one end in oil at the time of rotation of Rota 2 Herringbone groove 20a of the shape of a character of abbreviation "**" constituted by connecting the spiral slot of the pair which inclines in the direction which conflicts to a hand of cut is formed, and the up radial bearing section 20 is constituted between the peripheral faces of shaft 2b.
[0037]
The direction dimension of an axis is formed in size rather than the spiral slot where the spiral slot located in an upper part side is located in a lower part side, and herringbone groove 20a of the up radial bearing section 20 is formed so that the pressure which stuffs oil into a lower part side may arise, at the same time the maximum point of dynamic pressure occurs by the part deflected from the core of bearing to the lower part side according to rotation of Rota 2. The internal pressure of the oil held in this gap that pushes in and is located in a lower part side rather than the up radial bearing section 20 by ** is maintained more than atmospheric pressure.
[0038]
Moreover, herringbone groove 22a of the shape of a character of abbreviation "**" constituted by connecting

the spiral slot of the pair which inclines in the direction which conflicts to a hand of cut in order to carry out induction of the fluid dynamic pressure to oil at the time of rotation of Rota 2 is formed in the lower limit side, and the lower radial bearing section 22 is constituted by the inner skin of a sleeve 8 between the peripheral faces of shaft 2b.

[0039]

It is set up so that each spiral groove may generate the equivalent pumping force substantially, and a slot item called the tilt angle or the flute width, and the depth to a dimension and a hand of cut of the direction of an axis may become the same, i.e., herringbone groove 22a formed in the lower radial bearing section 22 is set up so that each spiral groove may become axial symmetry to the connection section. Therefore, in the lower radial bearing section 22, the maximum dynamic pressure appears in the direction center section of an axis of bearing.

[0040]

Furthermore, although not illustrated in a detail, spiral groove 24a of the pump in which carries out induction of the pressure which goes to the method of the inside of radial (shaft 2b side) to oil at the time of rotation of Rota 2 is formed in the end face by the side of the upper limit of housing 6, and the thrust bearing section 24 is constituted between the lower part side faces of rotor hub 2a.

[0041]

In addition, the free edge side edge side of shaft 2b and the inside of lock out edge 6a of housing 6 function as static pressure bearing using the internal pressure of the oil raised by spiral groove 24a of the thrust-bearing section 24 as they are explained in full detail behind.

[0042]

(3) An axial manner of support

Next, the axial manner of support by each bearing constituted as above-mentioned is explained in full detail.

[0043]

In the upper part and the lower radial bearing 20 and 22, with rotation of Rota 2, the pumping force by the herringbone grooves 20a and 22a increases, and fluid dynamic pressure arises. The pressure distribution in the upper part and the lower radial bearing sections 20 and 22 increase rapidly, and serve as the maximum from the both-ends side of the herringbone grooves 20a and 22a in near the connection section of each spiral groove. Using the fluid dynamic pressure besides generated in the section and the lower radial bearing sections 20 and 22, Rota 2 is supported from the direction of axis vertical section of a sleeve 8 and shaft 2b, and is bearing an alignment operation and the restoration operation which receives falling of Rota 2.

[0044]

In the thrust-bearing section 24, induction of the pressure which goes to the method of the inside of radial by spiral groove 24a of pump in at oil is carried out with rotation of Rota 2. The internal pressure of oil is raised, and while the fluid dynamic pressure which acts in the surfacing direction of Rota 2 occurs, the pressure of the whole oil held rather than the thrust bearing section 24 at the back side (lock out edge 6a side) of a bearing clearance will be maintained at positive pressure by the pressure which goes to the method of the inside of radial [this]. In addition, the fluid dynamic pressure by which induction is carried out in the thrust-bearing section 24 is extent which does not increase rapidly like the upper part and the lower radial bearing sections 20 and 22, and exceeds atmospheric pressure a little at the maximum. With the pressure which goes to the method of the inside of radial [which is generated in this thrust bearing section 24], the oil currently held at the back side of a bearing clearance will be in the condition of having been sealed on parenchyma in pressure from the thrust bearing section 24.

[0045]

By moreover, the thing for which the dynamic pressure which makes herringbone groove 20a formed in the up radial bearing section 20 a configuration unsymmetrical in the direction of an axis, and is pressed to a lower part side to oil is generated While generating the dynamic pressure which serves as the maximum by the part deflected a little from the core of the bearing to the lower radial bearing section 22 side and supporting shaft 2b from the direction upper part of an axis The pressure of the field between the up radial bearing section 20 and the lower radial bearing section 22 is maintained at the positive pressure more than atmospheric pressure, and generating of negative pressure is prevented.

[0046]

In addition, as above-mentioned, the pressure generated in the thrust bearing section 24 is extent exceeding atmospheric pressure a little, and is difficult to fully surface Rota 2 only now. However, since it is spread so that it may become a pressure equivalent to the internal pressure of the oil raised by the fluid dynamic pressure to which induction also of the internal pressure of the oil held between the end face of shaft 2b and the inside of housing 6 lock-out edge 6a as above-mentioned is carried out in the thrust bearing section 24

through the free passage hole 9, it functions as static pressure bearing. Collaboration with these thrust bearing section 24 and static pressure bearing enables it to fully surface Rota 2.
[0047]
By moreover, the thing for which the annular thrust yoke 26 which becomes an opposite location with the Rota magnet 12 of a bracket 4 from ferromagnetic material is arranged, and the magnetic-attraction force of the direction of an axis is generated between the Rota magnet 12 and a thrust yoke 26 It is made to balance with ****** of Rota 2 generated in static pressure bearing between the end face of the thrust-bearing section 24 and shaft 2b, and the inside of housing 6 lock-out edge 6a, and support of the thrust direction of Rota 2 is stabilized. As for the magnetic energization to such Rota 2, it is possible to make it act also by making different the magnetic core of a stator 14 and the Rota magnet 12 in the direction of an axis.
[0048]
(4) A configuration and an operation of a free passage hole
Direction slot of axis 8a prepared in the peripheral face of a sleeve 8 is formed of press working of sheet metal or cutting so that a cross-section configuration may turn into the shape of the shape of an abbreviation rectangle, the shape of a triangle, and a semicircle.
[0049]
If a sleeve 8 is attached in the inner skin of housing 6 so that it may illustrate to drawing 3 (b), the free passage hole 9 which continues the lower limit section from the direction upper limit section of an axis of a sleeve 8 between the inner skin of housing 6 and direction slot of axis 8a will be specified. In the free passage hole 9, oil is held succeeding the oil held in a series of bearing gaps as mentioned above. Moreover, the internal pressure of the oil held in the free passage hole 9 has balanced with the internal pressure of the oil held at each bearing.
[0050]
When the minute gap formed between the inner skin of a sleeve 8 and the peripheral faces of shaft 2b which the upper part and the lower radial bearing sections 20 and 22 consist of is maintaining the predetermined dimension, Or when the herringbone grooves 20a and 22a maintain a predetermined precision and are formed, it becomes equivalent [the oil held at each bearing] to the pressure generated in the thrust bearing section 24 at least, and the internal pressure of oil does not turn into negative pressure.
[0051]
According to however, the processing error of the inner skin of a sleeve 8, or the peripheral face of shaft 2b If the direction upper limit section side of an axis is formed more widely than a lower limit section side, the minute gap formed between the inner skin of a sleeve 8 and the peripheral face of shaft 2b The dynamic pressure which the lower radial bearing section 22 side generates exceeds the dynamic pressure generated in the up radial bearing section 20, and a flow of the oil which goes to an upper part side from the direction lower part side of an axis occurs. There is concern to which the internal pressure of the oil currently held at the lock out edge 6a, i.e., the back of bearing clearance, side of housing 6 turns into negative pressure. moreover, when the direction upper limit section side of an axis is formed more narrowly than a lower limit section side, the minute gap formed between the inner skin of a sleeve 8 and the peripheral face of shaft 2b The dynamic pressure which herringbone groove 22a prepared in the up radial bearing section generates turns into more than place constant pressure. When negative pressure occurs between the end face of shaft 2b, and the inside of lock out edge 6a of housing 6 and oil flows from the direction upper limit section side of an axis to a lower limit section side There is concern which the internal pressure of the oil between the end face of shaft 2b and the inside of lock out edge 6a of housing 6 increases beyond the need, and fault surfacing of Rota 2 generates.
[0052]
On the other hand, although attenuation is carried out, since the pressure generated in the thrust-bearing section 24 by forming the free passage hole 9 spreads a little to the oil held at the lock out edge 6a side of housing 6, in a normal state, the internal pressure of oil does not turn into negative pressure in this field.
[0053]
By moreover, the thing for which the dynamic pressure which makes herringbone groove 20a prepared in the up radial bearing section 20 a configuration unsymmetrical in the direction of an axis, and is pressed to a lower part side to oil is generated While the pressure of the field between the up radial bearing section 20 and the lower radial bearing section 22 is maintained at the positive pressure more than atmospheric pressure and generating of negative pressure is prevented By the thrust which herringbone groove 20a generates, oil should always pass between the end face by the side of the free passage hole 9 and also the upper limit of a sleeve 8, and the lower part side faces of rotor hub 2a from between the end face by the side of the lower radial bearing section 22 and the lower limit of a sleeve 8, and the insides of lock out edge 6a of housing 6. It is pressurized so that it may flow to the direction upper limit section side of an axis of the peripheral face of shaft 2b, and the

inner skin of a sleeve 8 and may return to the up radial bearing section 20, and a series of circuits are formed.
[0054]
since the tolerance to a processing error is markedly alike and is expanded while generating of air bubbles and generating of fault surfacing of Rota 2 by negative pressure are prevented, since the oil in a bearing clearance will always flow in the fixed direction and balance of a pressure is achieved by this, the yield is improved. By the way, since oil flows in the direction contrary to the above and a circuit is similarly formed of the differential pressure even when [which the maximum pressure of the fluid dynamic pressure generated in the lower radial bearing section 22 side generates in the up radial bearing section 20] a processing error becomes large so that it pushes in and exceeds **, differential pressure is canceled.
[0055]
In addition, the pressure of oil comes to be kept constant in a field [high pressure / atmospheric pressure] by arranging so that the end of the free passage hole 9 may carry out opening to the method side of the inside of radial rather than the thrust bearing section 24. Thus, the back side of bearing will be in the condition of having been sealed in pressure from this by the thrust bearing section 24.
[0056]
For example, since sufficient support rigidity is acquired while dynamic pressure predetermined by the homaxial receiving part has occurred at the time of stationary rotation of a motor also when opening of the end of the free passage hole 9 is carried out between bearing and the taper seal section, possibility that contact and sliding of bearing will occur is low. However, when the rotational speed of motors, such as the time of a halt of a motor, falls, the pressure of the oil currently highly maintained by bearing circles by parts other than the field where the end of the free passage hole 9 was sealed in pressure, i.e., the pressure of oil, carrying out opening to atmospheric pressure, the EQC, or the field not more than it will decline rapidly by differential pressure with the pressure of the oil of the opening part of the free passage hole 9.
[0057]
Thus, contact and sliding will occur in the member which broadcasts Rota 2 easily, or carries out eccentricity, and constitutes shaft 2b and sleeve 8 grade bearing from the pressure of bearing circles declining rapidly. Although the imbalance of the magnetic force which act between the weight imbalance of Rota 2 containing the record disk lay in rotor hub 2a , processing and the assembly tolerance of the member which constitute a motor or a stator 14 , and the Rota magnet 12 etc. be consider to be a cause , this be that contact and sliding of such bearing be repeat whenever a motor stop , and the wear and the damage on the member which constitute bearing become remarkable , and it reduce the dependability and the endurance of a motor .
[0058]
On the other hand, by carrying out opening of the free passage hole 9 to the method of the inside of radial of the thrust bearing section 24, until just before a motor stops completely, the pumping by spiral groove 24a acts, and induction of the fluid dynamic pressure which acts on the method side of the inside of radial continues being carried out to oil. Therefore, since the thrust bearing section 24 works as a pressure-septum, the fall of the pressure of bearing circles becomes loose, the contact and sliding of a member which constitute bearing are eased, and the fall of the dependability of a motor or endurance is controlled.
[0059]
(5) The configuration of a disk driving gear
The internal configuration of the common disk driving gear 50 to drawing 4 is shown as a mimetic diagram. The interior of casing 51 forms clean space with little dust, dust, etc. to the degree of pole, and the spindle motor 52 with which it was equipped with the disc-like disk plate 53 which memorizes information is installed in the interior. In addition, inside casing 51, the head migration device 57 in which information is written to the disk plate 53 is arranged, and this head migration device 57 is constituted by the actuator section 54 which moves the head 56 which write the information on the disk plate 53, the arm 55 supporting this head, a head 56, and an arm 55 to the necessary location on the disk plate 53.
[0060]
By using the spindle motor of the above-mentioned operation gestalt as a spindle motor 52 of such a disk driving gear 50, since the stability, dependability, and endurance of a spindle motor are improved while enabling low cost-ization at the thin shape-ized list of the disk driving gear 50, it can consider as a more reliable disk driving gear.
[0061]
As mentioned above, although 1 operation gestalt of the disk driving gear equipped with the spindle motor and this according to this invention was explained, various deformation thru/or corrections is possible for this invention, without not being limited to the starting operation gestalt and deviating from the range of this invention.

[0062]
For example, it is also possible to make the end face by the side of the lower limit of a sleeve 8 contact the inside of lock out edge 6a of housing 6, to prepare the radial slot which follows the end face by the side of the lower limit of a sleeve 8 at the inner skin and direction slot of axis 8a, and to aim at the free passage of oil.
[0063]
Moreover, the sleeve 8 chooses from the oil impregnation sintered-metal material of the porosity which sintered the pure metal material or copper powder of an aluminum system, such as an ingredient, a copper system ingredient, and a stainless steel rope, the end of iron powder, etc., and sank in oil etc. suitably and is usable.
[0064]
When a sleeve 8 is formed from porous oil impregnation sintered-metal material, the free passage of the direction both ends of an axis and free passage hole of oil which are held between the inner skin of a sleeve and the peripheral face of a shaft is especially attained through the hole in sintered-metal material. That is, the consideration to the wearing condition of a sleeve over housing is eased, and the degree of freedom of a design is expanded.
[0065]
Furthermore, the dynamic pressure generating slot formed in the upper part and the lower radial bearing sections 20 and 22 It is important to be arranged so that induction of the flow which always goes to an one direction to oil may be carried out. With the above-mentioned operation gestalt Although the dynamic pressure generating slot of the up radial bearing section 20 is set to herringbone groove 20a of a configuration unsymmetrical in the direction of an axis and the dynamic pressure generating slot of the lower radial bearing section 22 is set to herringbone groove 22a of a configuration symmetrical with the direction of an axis It is also possible to use the dynamic pressure generating slot of the up radial bearing section 20 as the herringbone groove of a configuration symmetrical with the direction of an axis, to push in the dynamic pressure generating slot of the lower radial bearing section 22 in the direction of an axis to oil as a herringbone groove of an unsymmetrical configuration, and to give **.
[0066]
In addition, using an unsymmetrical herringbone groove in the direction of an axis as a dynamic pressure generating slot of the up radial bearing section 20 or the lower radial bearing section 22 It sets it as the main purposes to give design top allowances so that it approves, and it may be stabilized and this can be supported by pushing in so that oil may always flow in the fixed direction, and giving **, even when a processing error arises in the inner skin of a sleeve 8 etc. Therefore, since it can push in by spiral groove 24a of the pump in established in the thrust-bearing section 24 to oil and ** can be given even if it is the case where the upper part and the lower radial bearing sections 20 and 22 prepare a herringbone groove symmetrical with the direction of an axis, even if there are little upper part and lower radial bearing section 20 and 22, it is not necessary to use one of dynamic pressure generating slots as a surely unsymmetrical herringbone groove.
[0067]
In addition, although the configuration which formed lock out edge 6a in housing 6 and one is illustrated with the above-mentioned operation gestalt, naturally it is also possible to make housing 6 into a bell shape and to consider one edge as the configuration which blockaded by the lock out member which consists of member with another housing 6.
[0068]
[Effect of the Invention]
While becoming possible to prevent generating of the negative pressure in oil, and generating of fault surfacing of Rota according to the spindle motor of claim 1, the contact and sliding of a member which constitute bearing are controlled and it becomes possible to maintain the dependability and endurance of a spindle motor highly.
[0069]
According to the spindle motor according to claim 2, the oil of bearing circles can be maintained at positive pressure also in the bearing of full philharmonic structure.
[0070]
According to the spindle motor according to claim 3, it becomes possible to form a free passage hole, without being accompanied by the difficulty of processing, and the increase of cost of a motor can be controlled.
[0071]
According to the spindle motor according to claim 4, the volume of the seal section can increase and the dependability and endurance of a motor can be improved.
[0072]
According to the spindle motor according to claim 5, the outflow of the oil to the bearing exterior by the oil

mist can be prevented more effectively.
[0073]
According to the spindle motor according to claim 6, Rota is depended and it can perform efficient and stabilizing and supporting.
[0074]
Since according to the disk driving gear according to claim 7 the stability, dependability, and endurance of a spindle motor are improved while enabling low cost-ization at a thin shape-ized list, it can consider as a more reliable disk driving gear.
[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing the outline configuration of the conventional spindle motor.
[Drawing 2] It is the sectional view showing the outline configuration of the spindle motor concerning the operation gestalt of this invention.
[Drawing 3] (a) is the partial expanded sectional view expanding and showing the configuration of the sleeve of the spindle motor illustrated to drawing 2 , and (b) is the partial expanded sectional view expanding and showing the configuration of bearing of the spindle motor illustrated to drawing 2 .
[Drawing 4] It is the sectional view showing the internal configuration of a disk driving gear typically.
[Description of Notations]
2 Rota
2a Shaft
6 Housing
8 Sleeve
9 Free Passage Hole
20 22 Radial bearing section
24 Thrust Bearing Section

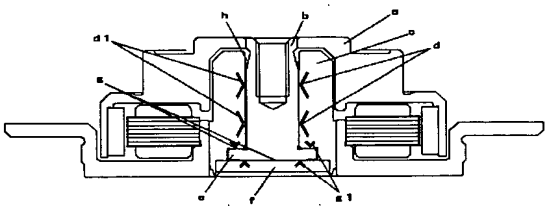
[Translation done.]

* NOTICES *

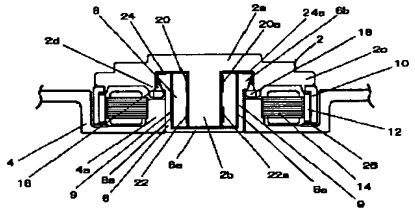
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

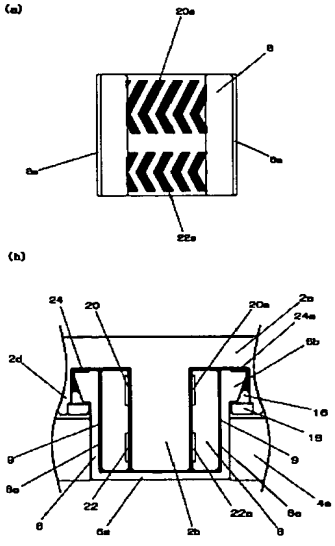
[Drawing 1]



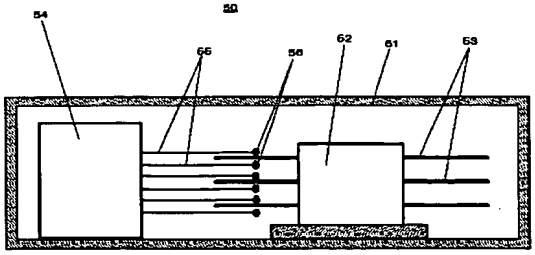
[Drawing 2]



[Drawing 3]



[Drawing 4]



[Translation done.]